

Watch Your Up-Convolution: CNN Based Generative Deep Neural Networks Are Failing to Reproduce Spectral Distributions

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Abstract

Generative convolutional deep neural networks, e.g. popular GAN architectures, are relying on convolution based up-sampling methods to produce non-scalar outputs like images or video sequences. In this paper, we show that common up-sampling methods, i.e. known as up-convolution or transposed convolution, are causing the inability of such models to reproduce spectral distributions of natural training data correctly. This effect is independent of the underlying architecture and we show that it can be used to easily detect generated data like deepfakes with up to 100% accuracy on public benchmarks. To overcome this drawback of current generative models, we propose to add a novel spectral regularization term to the training optimization objective. We show that this approach not only allows to train spectral consistent GANs that are avoiding high frequency errors. Also, we show that a correct approximation of the frequency spectrum has positive effects on the training stability and output quality of generative networks.